Update to April 6, 2021 Preliminary Report on Causes of Generator Outages and Derates During the February 2021 Extreme Cold Weather Event

ERCOT Public
April 27, 2021

Overview

This report provides aggregated information about the causes of generator outages and derates during the February winter storm event based on information provided in response to ERCOT Requests for Information.

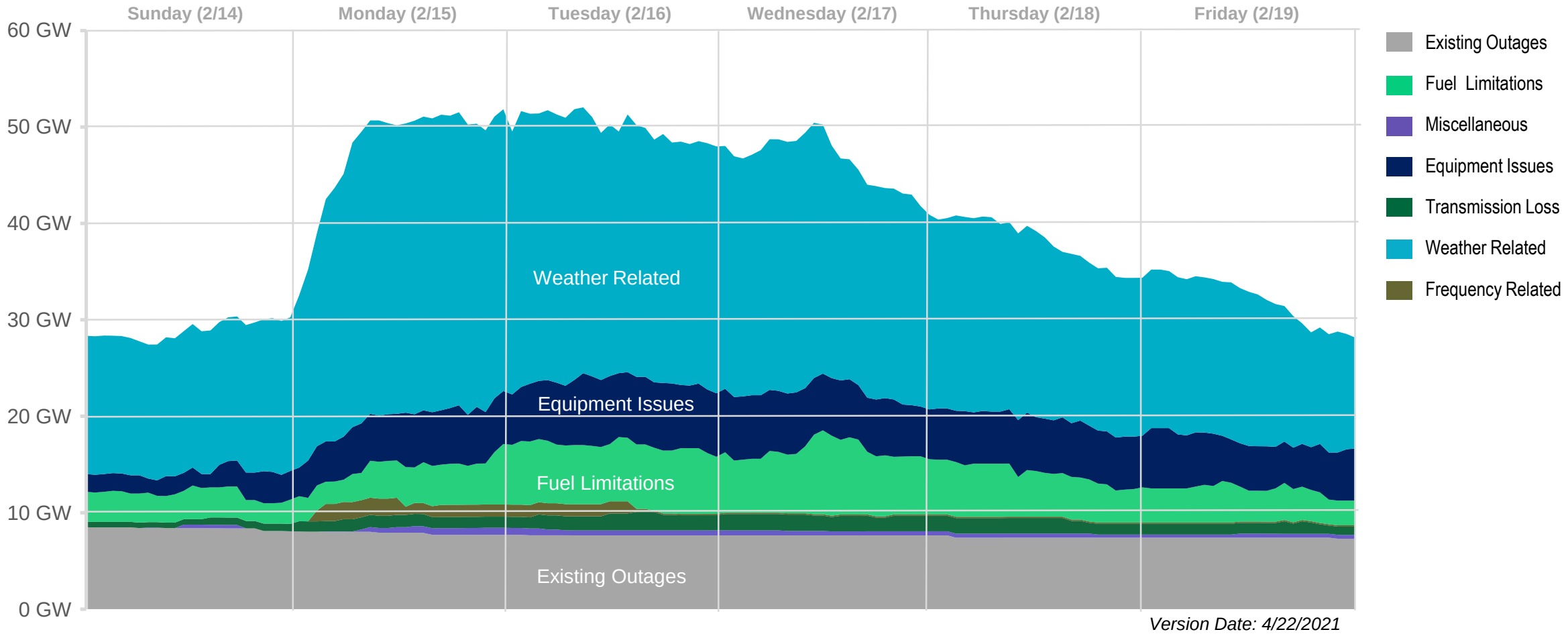
- On February 24, 2021, ERCOT sent Requests for Information (RFIs) to all Qualified Scheduling Entities (QSEs) that represent Generation Resources or Energy Storage Resources.
- The RFIs included questions about the causes of any generator outages and derates that occurred during the period of February 14-19, 2021, which were the days when the Energy Emergency Alert (EEA) was in effect.
- Using the RFI response information, ERCOT assigned each outage and derate to one of seven cause categories (*see slides 9-10 for a description of these categories*).
- The data in this report includes information about outages and derates entered by each QSE or Resource Entity into ERCOT's Outage Scheduler for the period February 14-19, 2021 as of 4 p.m. on March 4, 2021 (*Note: previously posted outage and derate data was based on entries as of February 20, 2021*).
- Following publication of the April 6, 2021 preliminary report, ERCOT requested that stakeholders provide written questions about the initial report. In response to the questions and comments received, ERCOT provides this updated version of the preliminary report with additional categorizations of the generation outage data. The supplemental analysis begins on slide 11.

Important Notes

- The information in this document is preliminary and subject to change.
- Slides 4, 6, and 8 have been revised in this updated report to accurately reflect the seasonal capacities of each generator for the time of the event and to correct other minor categorization issues.
- For the purposes of this document, an “outage” is the complete unavailability of a generator’s capacity, and a “derate” is the partial unavailability of that capacity.
- All generator outage and derate values reflected in the graphs are based on generator nameplate capacity—i.e., the maximum possible MW output specified by the generator manufacturer. Because wind and solar output is typically much lower than the specified nameplate capacity, the outage and derate MW values used for those units to develop this report are generally much higher than the actual amount of power that would have been available in the absence of the outage or derate.
- ERCOT cannot disclose the unit-specific outage causes because they are Protected Information.

Net Generator Outages and Derates by Cause (MW)

February 14 – 19, 2021



Net generator outages at the beginning of each hour on February 14-19, 2021, by cause category.

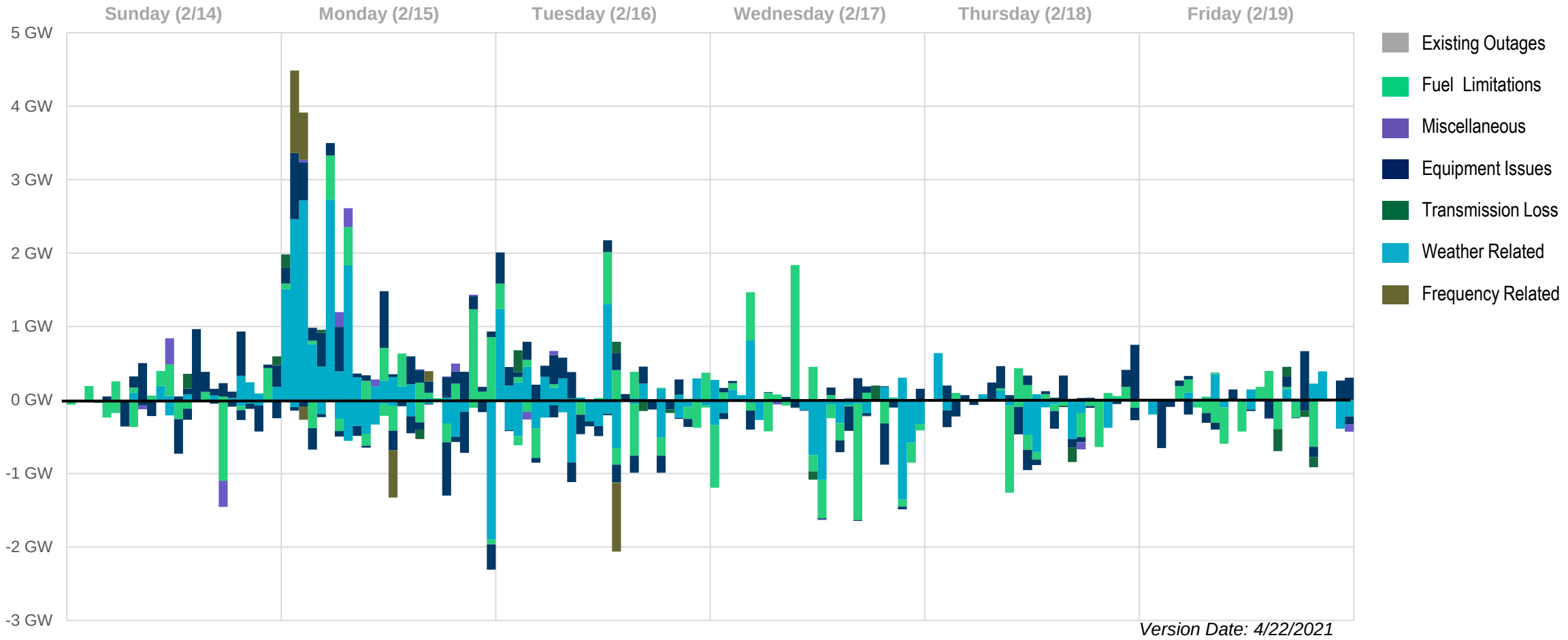
Continued Volatility of Generation Supply During the Event

- The amount of outaged capacity shown on the previous slide (slide 4) increased sharply as the storm arrived on Sunday and stayed fairly constant from late morning on Monday to mid-day on Wednesday.

- However, as shown on the next slide (slide 6), the net level of outages masks the volatility in generation availability that continued throughout the week, with generators continuing to go out of service and come into service throughout the duration of the event.

- This volatility made it difficult to accurately forecast an end to emergency conditions.

Incremental Generator Outage and Derates by Hour
starting 00:00 on 2.14.21



Outages and derates continued through the week at a high rate.

Explanation: Incremental Generator Outage and Derates by Hour

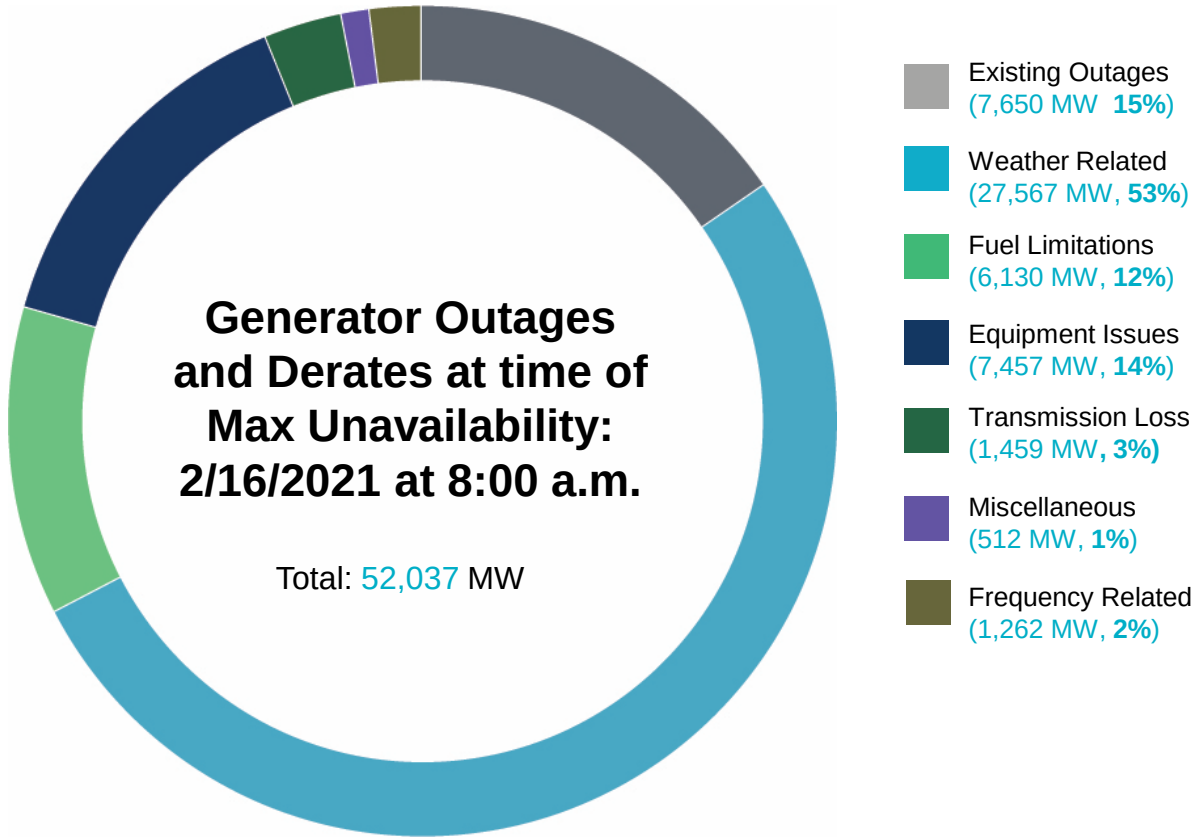
- The graph on the previous slide shows the generator outages and derates that started or ended in each hour on February 14-19, 2021, by cause category. The quantity of outages starting during a given hour are shown as positive values, and the quantity of outages ending during a given hour are shown as negative values.

- For example, if a 100 MW generator started an outage at 2 p.m. on February 14 due to a fuel limitation, and that outage ended at 5 p.m. on February 17, it would show as a positive 100 MW in the fuel limitation category for 2 p.m. on February 14 and a negative 100 MW in the fuel limitation category at 5 p.m. on February 17.

- This graph does not include the start of any outage or derate that occurred before February 14, but it does include the incremental reduction in outaged MW for any of those outages or derates that ended during the February 14-19 window.

Generator Outage and Derates: Maximum Unavailability

- The highest amount of unavailable capacity during the period of February 14-19, 2021 occurred on February 16 at ~8:00 AM and was 52,037 MW.
- This chart shows the MW of the generator outages or derates that were occurring at that point in time by cause category.
- Note that the total outaged and derated capacity at this time is different than what was previously reported (52,277 MW) due to additional information received in response to the RFIs.



Outage Cause Categories

Existing Outages:

Generator outages or derates that started before the issuance of the Operating Condition Notice on February 8, 2021; includes ongoing planned and forced outages as well as seasonally mothballed units. Some existing outages ended before or during the event, allowing the unit to return to service.

Fuel Limitations:

Generator outages or derates due to lack of fuel, contaminated fuel, fuel supply instability, low gas pressure, or less efficient alternative fuel supply.

Weather Related:

Generator outages or derates explicitly attributed to cold weather conditions in the RFI responses. This includes but is not limited to frozen equipment—including frozen sensing lines, frozen water lines, and frozen valves—ice accumulation on wind turbine blades, ice/snow cover on solar panels, exceedances of low temperature limits for wind turbines, and flooded equipment due to ice/snow melt.

Outage Cause Categories *(continued)*

Equipment Issues:
Generator outages or derates due to facility equipment failures or malfunctions not explicitly attributed to cold weather in the RFI response. This includes trips and derates related to control system failures, excessive turbine vibrations, or other equipment problems.

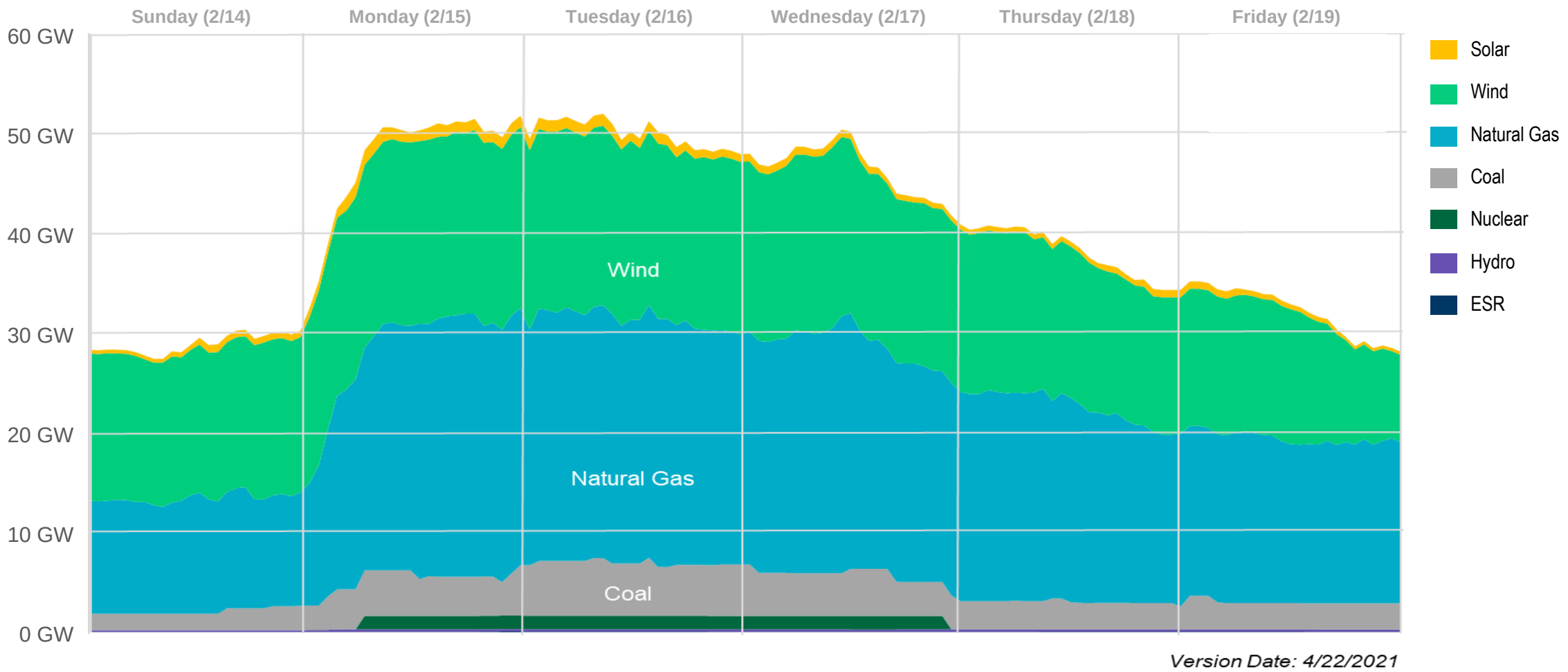
Transmission Loss:
Generator outage or derates due to forced outages on directly connected transmission facilities.

Frequency Related:
Generator outage or derates attributed to frequency deviations from 60Hz; includes automatic tripping due to under-frequency protection relays and any automatic or manual tripping attributed to plant control system issues related to frequency deviation.

Miscellaneous:
Other generator outages or derates not linked to one of the above causes, including outages for which a cause is yet unknown.

Supplemental Analysis

Net Generator Outages and Derates by Fuel Type (MW)



Outage and derate MW for Wind in this graph are based on capacity.

Actual Wind and Solar Production Lost Due to Outages and Derates

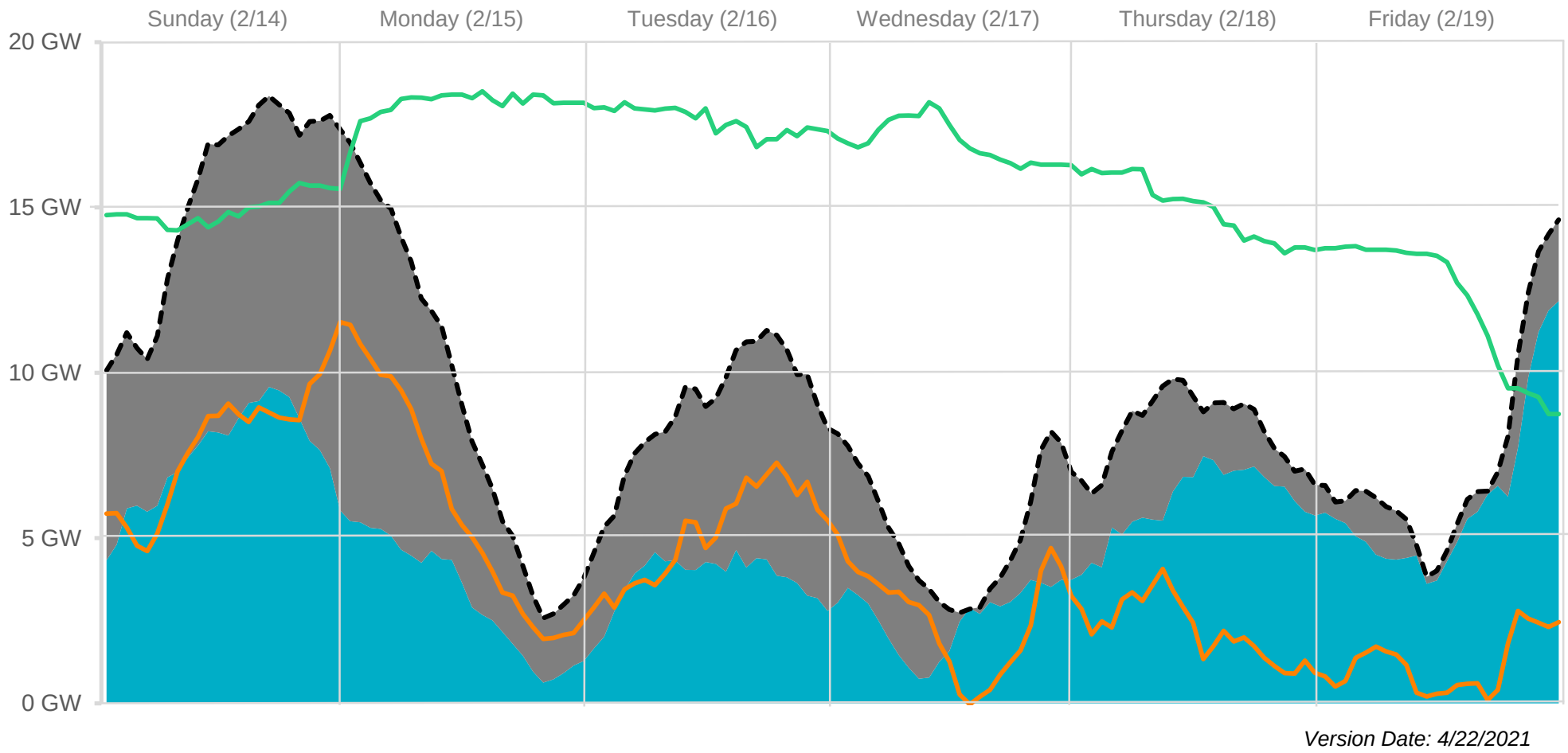
- The graphs in the April 6, 2021 version of this report (slides 4, 6, and 8) are based on the amount of capacity that was lost due to outages and derates, without regard to how much each generator would have otherwise produced during the period of the outage or derate.

- For wind and solar generators, using capacity values may not provide a complete picture of the actual energy production that was unavailable due to the outages; for example the outage of a solar generating unit at night would have no effect on the amount of generation that is available to serve consumers' demand.

- The graphs on the following two slides (slides 14 and 15) provide an estimate of the energy that would have been produced by wind and solar generation "but for" the reported outages and derates.
  - *For the wind generation estimate, ERCOT's wind forecast vendors produced a backcast of the systemwide MW that would have been produced by wind generators without outages or derates. The estimated lost output due to outages and derates is the difference between that systemwide backcasted value and the actual systemwide wind output.*
  - *For the solar generation estimate, ERCOT scaled the actual solar energy production up by the portion that reported an outage or derate of the total solar capacity.*

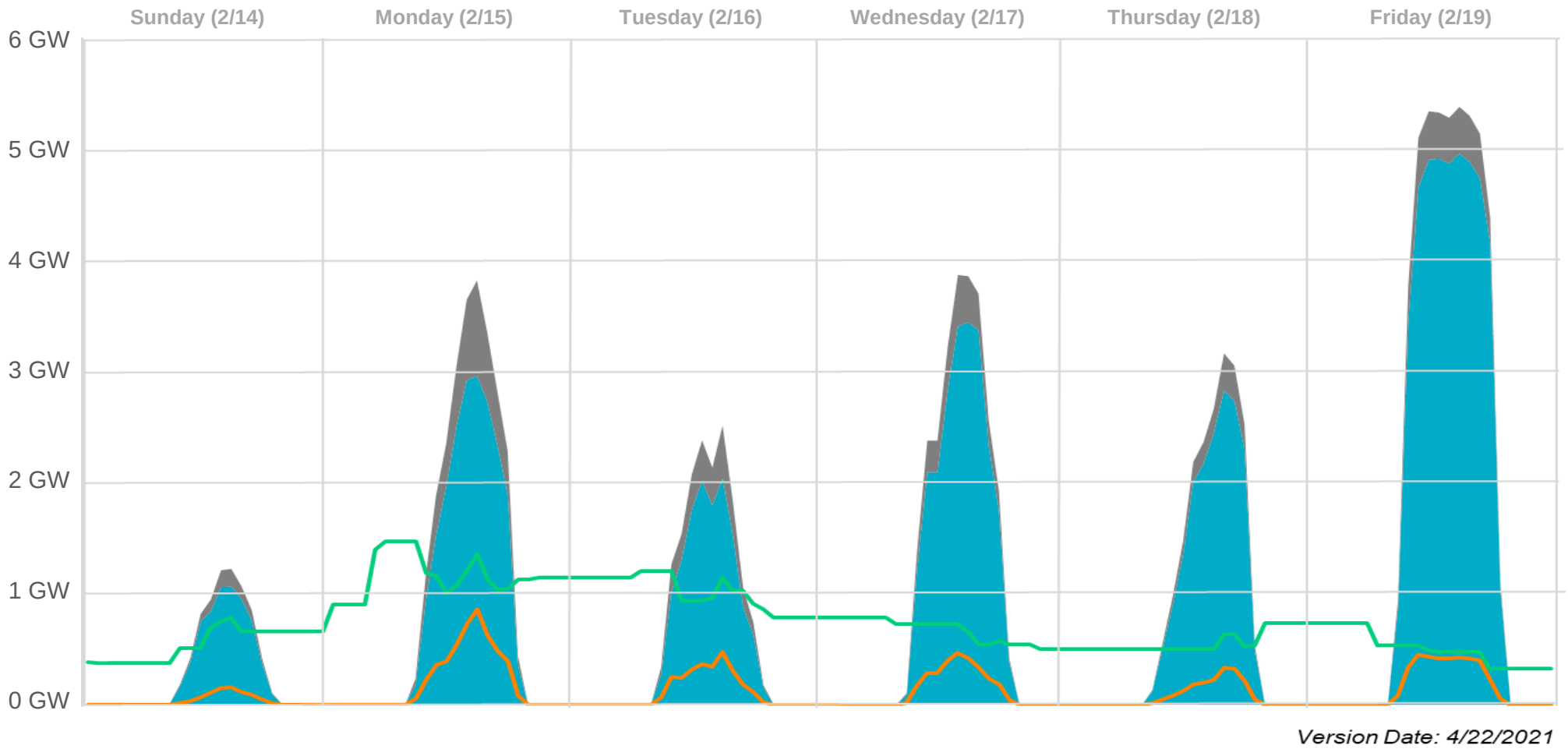
- These estimates were then used to reproduce the Net Generator Outages and Derates by Fuel Type graph on slide 16 based on the actual wind and solar production lost due to the outages or derates of solar and wind generation units.

Estimated Impacts of Outages and Derates on Wind Output



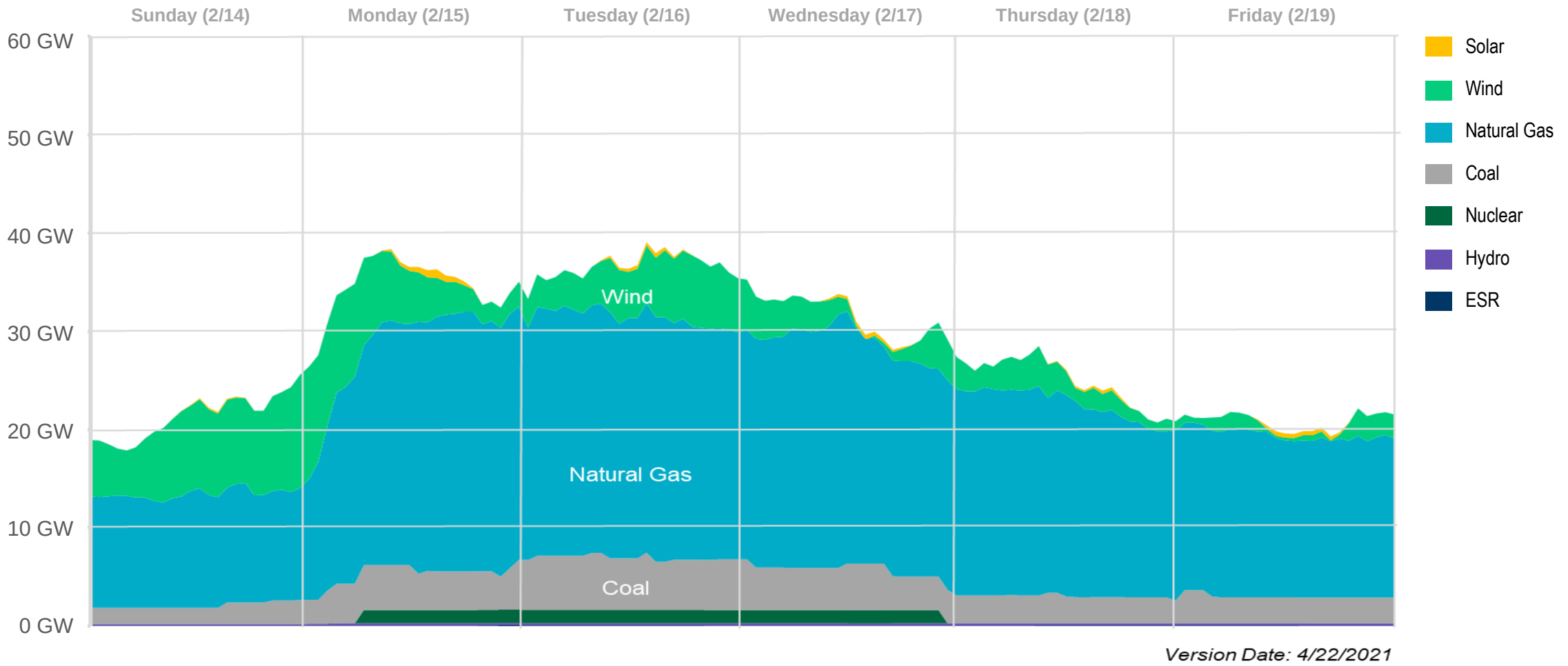
Magnitude of orange line and gray area are both equal to the estimated impact of wind outages and derates.

Estimated Impacts of Outages and Derates on Solar Output



Magnitude of orange line and gray area are both equal to the estimated impact of wind outages and derates.

Net Generator Outages and Derates by Fuel Type (MW)



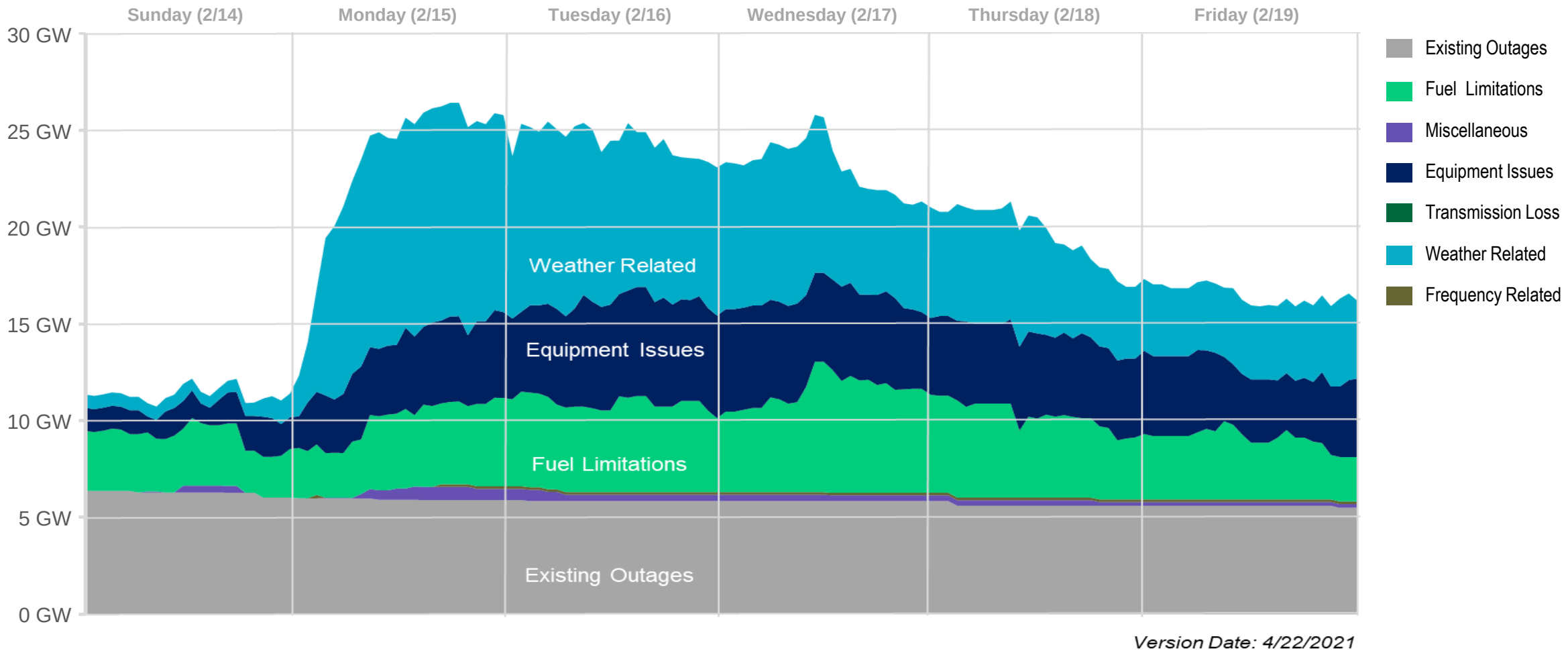
Wind and solar MW values based on estimated lost output due to outages and derates from slides 15 and 16.

Outage and Derate Causes by Fuel Type

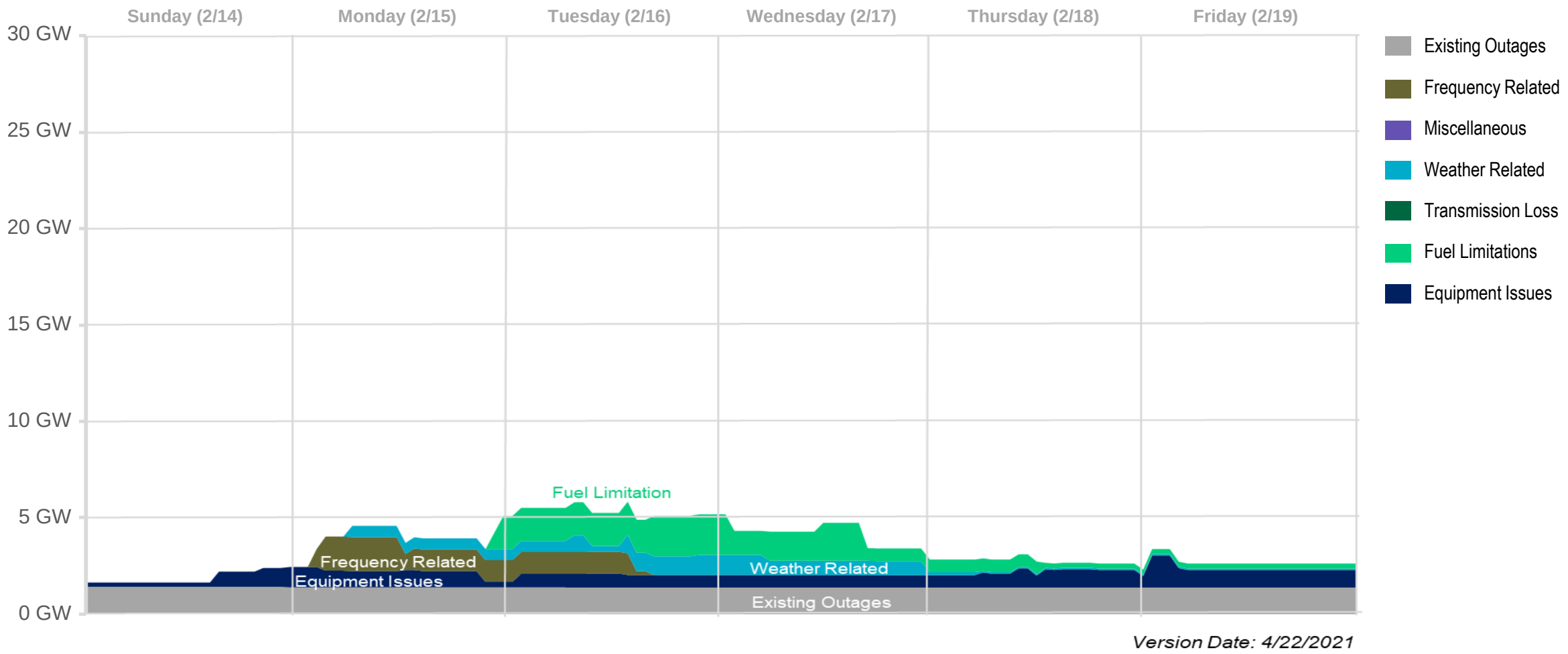
The graphs on the following slides show the cause categories of the net outages or derates for each fuel type.

- Graphs are included for gas, coal, and wind generator outages and derates.
- For wind generators, the outages and derate values on slide 20 are based on capacity, and the values on slide 21 are based on estimated lost wind output. On slide 21, the allocation of the lost wind output to each cause code is based on the proportion of total outaged wind capacity assigned to each cause for each hour; this is an approximation, as the backcasted lost output is not available on a unit-by-unit basis.
- Graphs are not included for nuclear, hydro, solar and energy storage because the number of outages is small and it would be possible to identify individual generating unit outage causes.

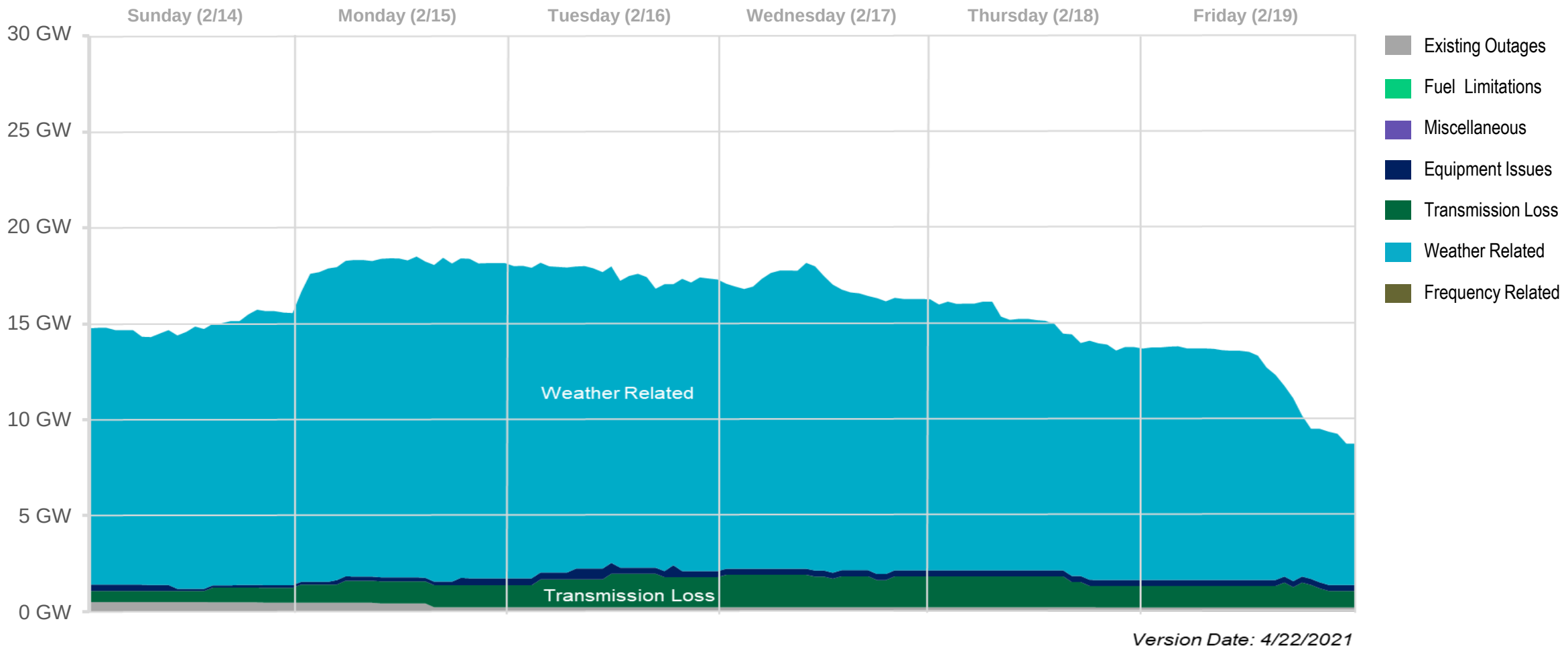
Net Generator Outages or Derates for Natural Gas Generators by Cause



Net Generator Outages or Derates for Coal Generators by Cause

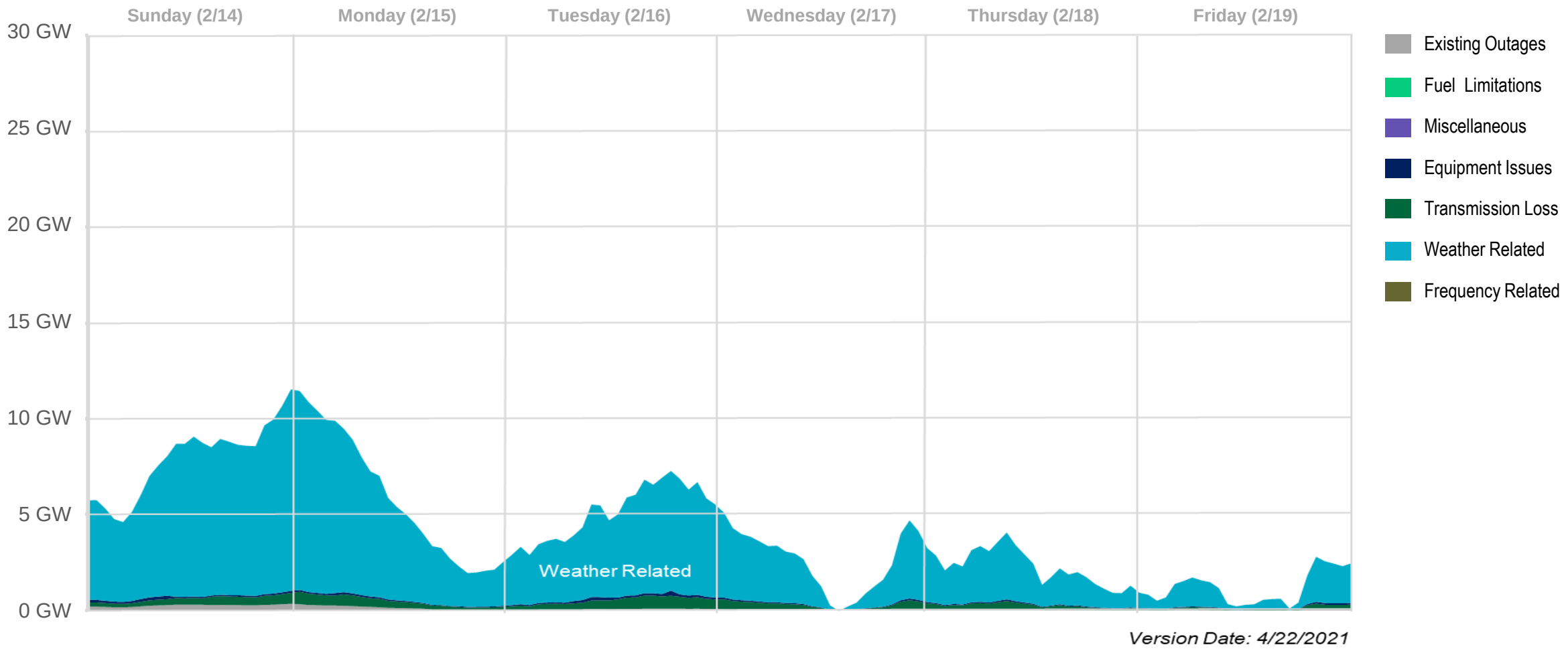


Net Generator Outages or Derates for Wind Generators by Cause



Outage and derate MW values are based on capacity.

Net Generator Outages or Derates for Wind Generators by Cause



Outage and derate MW values are estimated based on the proportion of total outaged wind capacity assigned to each cause for each hour.

Outage and Derate Causes by Sub-causes

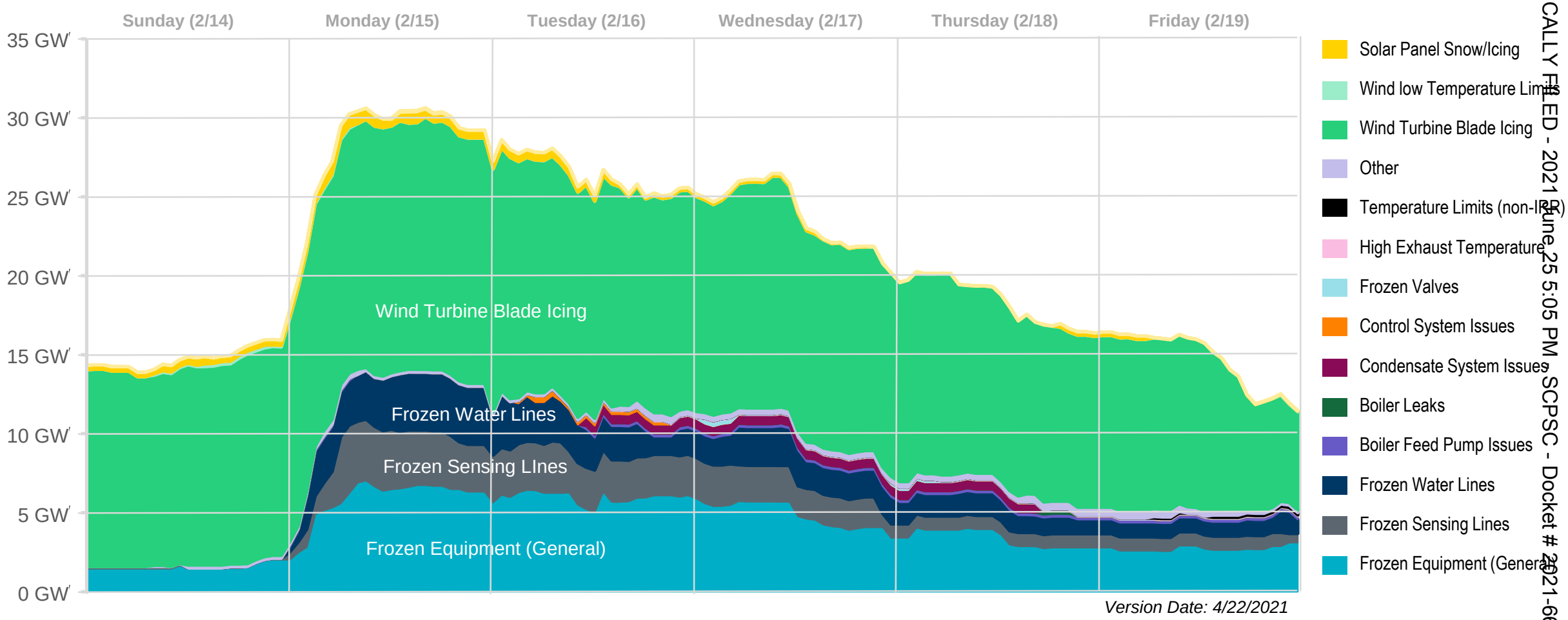
ERCOT has further divided the Weather Related and Fuel Limitations cause categories into sub-categories of causes. These subcategories are as follows:

- **Weather Related**
  - Boiler Feed Pump Issues
  - Boiler Leaks
  - Condensate System Issues
  - Control System Issues
  - Frozen Equipment (General)
  - Frozen Sensing Lines
  - Frozen Valves
  - Frozen Water Lines
  - High Exhaust Temperatures
  - Temperature Limits (non-IRR)
  - Solar Low Temperature Limits
  - Wind Low Temperature Limits
  - Solar Panel Snow/Icing
  - Wind Turbine Blade Icing
  - Other
- **Fuel Limitations**
  - Fuel Contamination
  - Fuel Equipment Issues
  - Fuel Impacted by Weather
  - Fuel Other
  - Fuel Pressure Issues
  - Fuel Switching
  - Lack of Fuel

The following three graphs show the outages and derates by sub-cause for the Weather Related and Fuel Limitation outages and derates

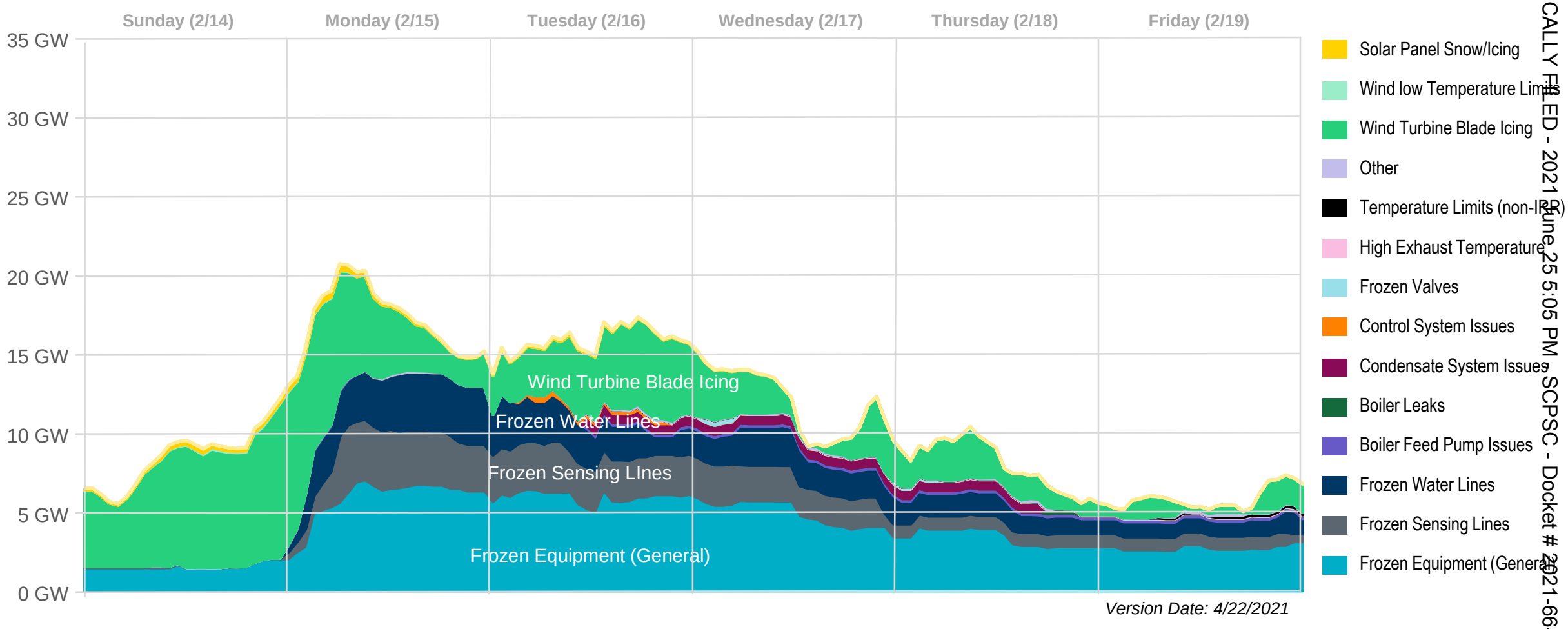
- *Slide 23 provides the sub-causes for the Weather Related outages using the capacity for wind outages. Slide 24 uses the estimated lost output due to outages and derates for wind outages based on the proportion of total outaged wind capacity assigned to each cause for each hour.*
- *Slide 25 provides the sub-causes for the Fuel Limitations outages.*

Weather Related Generator Outages and Derates by Sub Cause



Outage and derate MW for wind and solar are based on capacity.

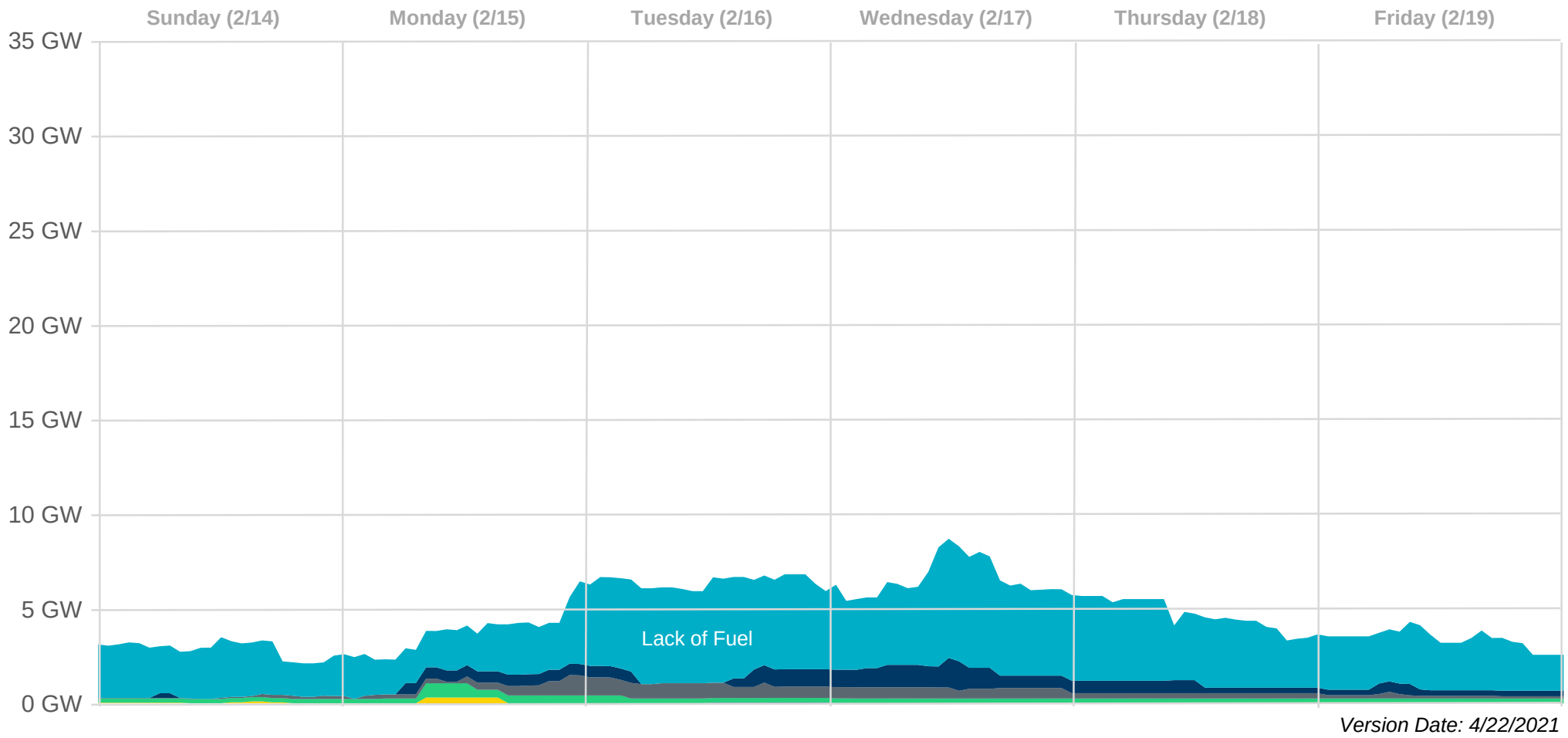
Weather Related Generator Outages and Derates by Sub Cause



Version Date: 4/22/2021

Outage and derate MW for wind are estimated based on the proportion of total outaged wind capacity assigned to each cause for each hour.

Fuel Limitations Generator Outages or Derates by Sub Cause



Version Date: 4/22/2021